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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/675,798	09/30/2003	T. Warren Weeks JR.	N0400.70001US01	2233

7590 02/28/2007  
Robert H. Walat  
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600 Atlantic Avenue  
Boston, MA 02210

EXAMINER
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BLACKWELL, GWENDOLYN ANNETTE

ART UNIT	PAPER NUMBER
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1775

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/28/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

## Office Action Summary

Application No.

10/675,798

Applicant(s)

WEEKS ET AL.

Examiner

Gwendolyn Blackwell

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 27 November 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,4,7-14,18-28,30-35 and 86-90 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,4,7-14,18-28,30-35 and 86-90 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application
- ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 27, 2006 has been entered.

### *Claim Rejections - 35 USC § 102/103*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

*(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

*(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.*

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was

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made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1, 4, 7-14, 18-24, 26-28, 32-35, 87-88, and 90 are under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over United States Patent no. 5,874,747, Redwing et al.

*Regarding claims 1-8, 10-14, 19, and 35*

Redwing discloses a GaN alloy layer grown on a substrate that can be SiC or Si with a transition layer grown between the substrate and the GaN layer, (column 4, lines 62-65). The gallium nitride can be single crystal, (column 7, lines 8-12).

There are no specific examples utilizing a Si substrate instead of an SiC substrate. In the alternative it would have been obvious to one skilled in the art at the time of invention to use Si instead of SiC as Redwing specifically discloses that "[t]he quality of GaN grown on lattice mismatched substrates such as sapphire, Si, GaAs and SiC is greatly improved when a buffer or transition layer is grown on the substrate prior to the growth of the GaN layer", (column 4, lines 62-65), meeting the requirements for claims 1, 19, and 35.

The composition of the transition layers can be continuous along the thickness or graded stepwise or incrementally, meeting the requirements for claim and 14, (column 22, lines 39-47). The transition layer comprises gallium nitride, which is compositionally graded comprising the formulas  $Al_xGa_{1-x}N$  where the value of x ranges from 0 to 1. The value of x can be 0 to 1 starting from the substrate or 1 to 0 starting from the substrate, meeting the requirements of claims 4, 7-8, 11-13, and 87-89, (column 7, lines 15-30). The composition of gallium nitride can

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also be  $\text{In}_x\text{Ga}_{1-x}\text{N}$  with the range of  $0.05 < x < 0.5$  and  $\text{Al}_y\text{Ga}_{1-y}\text{N}$  where  $y$  ranges between 0 to 0.3, meeting the requirements of claim 10, (column 14, lines 18-22).

*Regarding claim 20*

Redwing also discloses that the gallium nitride may be a superlattice such as  $\text{M}_{1-x-y}\text{M}'_y\text{Ga}_x\text{N}$  wherein  $x$  and  $y$  range from 0 to 1 and  $M$  is a metal compatible with Ga and N and  $M'$  is a compatible metal providing quaternary compounds such as  $\text{AlInGaN}$ , meeting the requirement of claim 20, (column 14, lines 46-68; see also claims 25-30).

*Regarding claims 9, 18, 21-24, 26-28, 32-34, and 90*

Redwing further discloses that the transition layer has a thickness between 200 angstroms to 5  $\mu\text{m}$ , meeting the requirements of claims 18 and 21, (column 7, lines 30-32). The invention of Redwing can be a LED, LD, or semiconductor device, meeting the requirements of claims 22-24, (column 9, lines 55-60). The present invention has a structure, which eliminates cracking, meeting the requirements of claims 26-28, (column 18, lines 53-56). An intermediate layer may be placed between the substrate and the transition layer, meeting the requirements of claim 32, (column 19, lines 23-29). The intermediate layer can be a thin layer of  $\text{AlN}$ , or can be comprised of a thin compositionally graded buffer layer alloy of gallium nitride such as  $(\text{Al}, \text{In})\text{N}$ ,  $(\text{Al}, \text{Ga})\text{N}$ ,  $(\text{Al}, \text{Ga}, \text{In})\text{N}$ ,  $(\text{In}, \text{Ga})\text{N}$ , meeting the requirements of claims 9, 33-34, and 89, (columns 19-20, lines 23-19).

*Regarding claim 25*

The phrase "wherein the semiconductor material forms a FET" is considered a statement of intended use. The intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed

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invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963). Because the layer structure of Redwing et al is not structurally different from the semiconductor material as claimed by Applicant, the semiconductor material as claimed does not provide patentable distinction over the prior art of record.

***Claim Rejections - 35 USC § 102***

5. Claims 1, 4, 7-14, 19-23, 25-28, 32-33, 35, and 88-90 rejected under 35 U.S.C. 102(e) as being anticipated by United States Patent Application Publication no. 2002/0020341, Marchand et al.

*Regarding claims 1, 4, 7-14, 19-21, 26-28, and 88-89*

Marchand et al disclose the growth of crack free layers of GaN on silicon substrates wherein the film is achieved through the use of a continuous graded (transition) film going from material A which has a high aluminum composition ( $\text{AlN}$ ,  $\text{Al}_{0.5}\text{Ga}_{0.5}\text{N}$ ) to a material B that has a low aluminum composition ( $\text{GaN}$ ,  $\text{Al}_{0.2}\text{Ga}_{0.8}\text{N}$ ), (page 2, section 0015). Over this graded layer additional layers of GaN or AlGaInN having a thickness exceeding 5 micrometers can be formed, (page 4, section 0038). As the coating is considered crack free, Applicant's limitation of less than 0.005 micrometers/micrometers<sup>2</sup> is met absent an evidentiary showing to the contrary, meeting the limitations of claims 1, 4, 7-14, 19-21, 26-28, and 88-89.

*Regarding claims 18, 22-23, 25, 32-33, 35, and 90*

The graded portion of the coating is about 20-80% of a one micrometer thick film, (page 3, section 0026), meeting the limitations of claim 18.

In one example, a silicon layer (intermediate layer) is grown on a silicon wafer with the graded layer grown on the intermediate layer, (page 3, section 0034), meeting the limitations of claims 32-33, 35, and 90.

The coated substrate can be used as part of an FET or LED (semiconductor device), (page 2, section 0015), meeting the limitations of claims 22, 23, and 25.

***Claim Rejections - 35 USC § 103***

6. Claims 25, 30-31, and 86 are rejected under 35 U.S.C. 103(a) as being unpatentable over United States Patent no. 5,874,747, Redwing et al as applied to claims 1 and 22 above, in view of United States Patent no. 6,426,512 B1, Ito et al further in view of United States Patent no. 6,287,947, Ludowise et al.

Redwing et al disclose the limitations of claims 1 and 22 above. Redwing et al also disclose that the invention can be a LED, LD, or semiconductor device, (column 9, lines 55-60). The present invention has a structure that eliminates cracking, (column 18, lines 53-56). Redwing et al do not specifically disclose that the semiconductor device is an FET or the size of the substrate as exemplified by Applicant or that the silicon substrate is textured.

Ito et al disclose a semiconductor device that utilizes a group III nitride compound, such as GaN and it's alloys, wherein the substrate can be SiC or Si, (column 4, lines 50-67). Ito et al also disclose that a "FET structure can be also formed from group III nitride compound semiconductors," (column 8, lines 56-65). Between the substrate and the GaN layer is an undercoat layer and a buffer layer, wherein the buffer layer is  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  ( $0 \leq x \leq 1$ ), (column 16, lines 65-67). The thickness of the substrate can be 300  $\mu\text{m}$ , (column 13, examples).

Ludowise et al disclose structures related to GaN based LEDs and LDs comprised of a substrate and a number of layers, (column 5, lines 47-48). The substrate can be comprised of silicon containing materials wherein the surface of the substrate is textured, (column 5, lines 51-56).

Redwing et al, Ito et al, and Ludowise et al disclose analogous inventions related to better ways to improve the lattice mismatch between the GaN layer(s) and the substrate. It is known in the art that Si, SiC, and sapphire can be used as substrates in the manufacturing of FETs, LDs, and LEDs. It is also known that the lattice mismatch between GaN and a Si or SiC substrate can be decreased by the use of a buffer layer, (Redwing, col. 4, lines 62-65). It is also known that Si is less expensive than SiC when used a substrate for a semiconductor device. Therefore it would have been obvious to one skilled in the art at the time of invention to modify the semiconductor device of Redwing with the Si substrate of Ito to create a FET that is less expensive to manufacture. It would also be within the skill of one in the are at the time of invention to modify the substrate of the Redwing/Ito invention in order to randomize the incident light and increase the probability of incident light escaping the LED through the sides or upper surface of the semiconductor region, (column 5, lines 47-62).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to adjust the diameter of the substrate through routine experimentation in order to achieve a semiconductor device that has improved structural and optical properties. It has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).



***Response to Arguments***

1. Applicant's arguments filed November 27, 2006 have been fully considered but they are not persuasive with respect to the rejections of claims 1, 4, 7-14, 18-24, 26-28, 32-35, 87-88, and 90 under 35 U.S.C. 102 and claims 25, 30-31, and 86 under 35 U.S.C. 103(a). All other objections based on the Office Action dated October 19, 2005 have been overcome.

2. With regards to the 35 U.S.C. 102(b) rejection, Applicant contends that USPN 5,874,747, Redwing, does not disclose growing a thick gallium nitride material having a low crack level on a silicon substrate as Redwing only generally teaches that gallium nitride can be grown on silicon in the background of the section of the patent.

This is not held persuasive as Redwing demonstrates that it is known to grown gallium nitride Redwing on a substrate that can be SiC or Si with a transition layer grown between the substrate and the GaN layer, (column 4, lines 62-65). As such is known, even though Redwings examples are to GaN grown on silicon carbide, it would be expected that one in the art could apply the same principles to grow GaN on silicon. The prior art's teachings are not limited to the preferred embodiments but the teaching as whole. A reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill the art, including nonpreferred embodiments. *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), *cert. denied*, 493 U.S. 975 (1989). A reference is no less anticipatory if, after disclosing the invention, the reference then disparages it. The question whether a reference "teaches away" from the invention is inapplicable to an anticipation analysis. *Celeritas Technologies Ltd. v. Rockwell International Corp.*, 150 F.3d 1354, 1361, 47 USPQ2d 1516, 1522-23 (Fed. Cir. 1998)

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(The prior art was held to anticipate the claims even though it taught away from the claimed invention. "The fact that a modem with a single carrier data signal is shown to be less than optimal does not vitiate the fact that it is disclosed.").

3. Applicant also contends that the light-emitting device of Redwing would not function properly with a silicon substrate. Applicant further contends that before the priority date of December 14, 2000, there was no reasonable expectation that the semiconductor material of present claim 1 could be successfully formed in view of the teachings of Redwing

Applicant has not demonstrated through objective evidence that using the invention of Redwing with a silicon substrate would not work/be inoperable. Objective evidence which must be factually supported by an appropriate affidavit or declaration to be of probative value includes evidence of unexpected results, commercial success, solution of a long-felt need, inoperability of the prior art, invention before the date of the reference, and allegations that the author(s) of the prior art derived the disclosed subject matter from the applicant. The arguments of counsel cannot take the place of evidence in the record. *In re Schulze*, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965). *MPEP 716.01*.

4. With regards to the 35 U.S.C. 103(a) rejection, Applicant contends that one skilled in the art would not be motivated to combine Redwing and USPN 6,426,512, Ito.

The same arguments stated above for the 102(b) rejection are repeated to the Redwing reference applied in the 103(a) obviousness rejection. Please see comments above. The concentration of Redwing on SiC as a substrate does not explicitly teach away from the use of silicon as Redwing has disclosed that silicon can be used as a substrate to grow GaN while utilizing a transition layer between the substrate and the GaN film.

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5. Applicant also contends that there would be no expectation of success in the combination of Redwing and Ito and Redwing and USPN 6,287,947, Ludowise.

The Examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, all three references teach the use of gallium nitride on a substrate comprising silicon, which makes up a semiconductor device. Ito is used to demonstrate that a structure having a GaN layer formed on SiC or Si can be used as an FET structure. Ludowise is used to demonstrate that GaN based LEDs and LDs, which are taught by Redwing, can be used on textured substrates comprised of silicon. Outside of arguments, Applicant has not provided any objective evidence to support their contents.

6. In view of the responses above, the rejections of claims 1, 4, 7-14, 18-28, 30-35, and 86-90 stand rejected under the appropriate 35 U.S.C. 102(b) or 103(a).

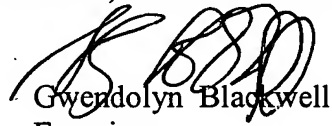
### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gwendolyn Blackwell whose telephone number is (571) 272-1533. The examiner can normally be reached on Monday - Thursday; 6:30 am - 5:00 pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on (571) 272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

  
Gwendolyn Blackwell  
Examiner  
Art Unit 1775

gab